Seabed mapping and Vulnerable Marine Ecosystems protection in the high-seas fisheries: Four case studies on progress in the Atlantic Ocean

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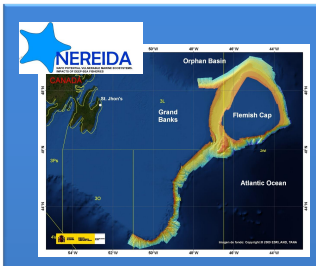
INTRODUCTION

In response to the United Nations General Assembly Resolution on sustainable fisheries (Res 61/105), Spain has led four projects on Vulnerable Marine Ecosystems (VMEs) in the some of the main high-seas fisheries of the Atlantic Ocean beyond national jurisdictions (Figs. A to D). The Spanish Institute of Oceanography was the responsible for the scientific aspects, planning and execution of work.

METHODOLOGY

The Spanish Observer Program and the vessel monitoring system were used to identify the fisheries footprint at different regions. Cooperative surveys with fishers enabled the study of the effects of fishing on the seabed and provide the first information on the distribution of VMEs indicator species. Scientific surveys supplied the collection of bathymetry and backscatter data (Simrad EM-302 multibeam echosounder) and the high resolution seismic profiles (Topas PS018) to study seabed characteristics. Dredge samples supported geophysical studies. Composition and distribution of benthic communities were studied using bottom trawls, rock dredges and box corers. Nets of CTD stations were used to study hydrographical conditions. Live images of the benthic ecosystems were obtained using video, photography and Remote Operated Vehicles.



NEREIDA benthic studies

Rock dredge

Box corer

CURRENT SITUATION

Data collected on VMEs indicators are being used in VME NAFO Working Groups as key information to produce analyses that are used to refine boundaries of the 12 currently closed areas in the NAFO Regulatory area. The suitability of such closures is to be reviewed by NAFO in September 2014.

NEREIDA

NW Atlantic (Slopes of the Grand Banks, Flemish Cap and Flemish Pass) NAFO Regulatory Area

- 6 Multidisciplinary international research cruises in 2009 and 2010 (R/V Miguel Oliver)
- 2 ROV surveys (CGS Hudson)
- 68,900 km² surveyed with a multibeam echosounder
- 18,600 km of seismic profiles
- 341 Box corers
- 104 Rock dredges
- 414 CTD
- 2143 photographs and 116 hours of video

NEREIDA project is a Spanish-led multidisciplinary international research project involving active participation by Spain, Canada, UK and Russia. NEREIDA field work was completed in 2009 and 2010 using to vessels: Spanish R/V Miguel Oliver and Canadian vessel CGS Hudson. The main objective of the project is focused on the implementation of the Ecosystem Approach to the fisheries management in order to identify and protect VMEs in the NAFO Regulatory Area.

NE Atlantic (Hatton Bank) NEAFC Area

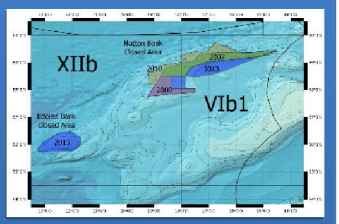
ECOVUL-ARPA PROJECT

3 Multidisciplinary research cruises in 2005, 2006 and 2007
- 18, 823 km² surveyed with a multibeam echosounder
- 1,121 km of seismic profiles
- 38 Bottom trawls
- 13 Box corers
- 22 Rock dredges
- Distribution of fishing effort from scientific observers and VMS graphics
- 3 cooperative surveys carried out in collaboration with fishers

As a result of the research, the fisheries footprint of the Spanish bottom trawl fishery, one of the most important deep-sea fisheries in the Hatton Bank, was described for the period 1996-2006. Moreover, cold-water coral ecosystems, sponges dominated communities and vulnerable morphological features (e.g. carbonate mounds, rocky outcrops, etc.) were identified in the study area, as well as an extensive sedimentary deposit (Hatton Drift) where cold-water coral reefs were absent.

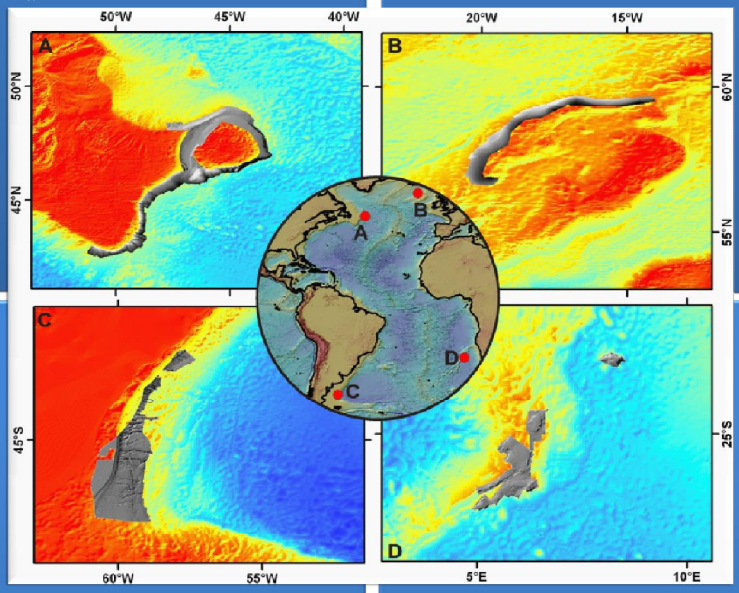
CURRENT SITUATION

Data collected on VMEs indicators (vulnerable species and habitats) fed the ICES VMEs database. Such information was key to advice on the delineation of closed areas to bottom fishing to protect cold-water corals and sponge aggregations.



Hatton Bank and Edoras Bank Closed Areas established between 2007 and 2013

ECOVUL-ARPA



SW Atlantic Patagonian shelf and slope

Coral gardens bottoms in the SW Atlantic

ATLANTIS PROJECT

13 multidisciplinary research cruises from 2007 to 2010
- 59 105 km² surveyed with a multibeam echosounder
- 91 905 km of seismic profiles
- 413 Bottom trawls
- 102 Rock dredge
- 209 Sedimentary dredge
- 519 CTD stations

CURRENT SITUATION

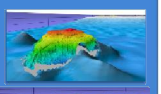
The research undertaken and its main findings led to the delineating of several areas to be protected, according to biological and geological criteria adopted for the quantitative, qualitative and geographic description of the areas with the presence of organisms classified as vulnerable.

Nine large areas or regions along the Patagonian Shelf and slope were identified as VMEs and were designated as candidate areas for closure (a total of ~41,300 km²). According to this scientific advice, the Spanish Government implemented a fishing ban for the Spanish bottom trawling fleets in the high seas of the Southwest Atlantic on 1st July, 2011.

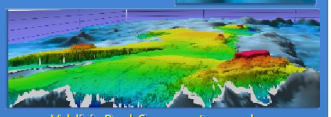
ATLANTIS

The ATLANTIS project swath-mapped for the first time large areas of the Argentine Continental Margin from 41º 30´S to 48ºS, obtaining full data coverage of the seafloor in this region between the outermost continental shelf and the middle slope down to 1600 m water depth contour. The benthic megafauna showed a clear dominance in biomass and diversity of the phyla Porifera and Cnidaria. The vulnerable habitats found in the study area are: i)Deep-sea sponge fields or sponge aggregations consisted mainly of two Porifera classes, Hexactinellida and Demospongiae; ii)Deep-sea corals -also known as cold-water corals- which belong to the Phylum Cnidaria; iii)Coral gardens which are characterized by their relatively dense aggregation of colonies, individuals or several coral species and, iv)Deep-sea rocky environments, they host a high number of rare or endemic species and they are important for the survival, functionality or recovery of fish populations. In the study area, vulnerable species are mainly distributed in areas located between 400 and 1000 m depth and where the sea bottom temperature ranges from 2.7ºC to 4.5ºC. Most organisms found in these depths are considered as vulnerable according to FAO, UN and OSPAR criteria, showed an important increase in taxons, number and biomass of octocorals, sponges, colonial scleractinians (*Bathelia candida*), antipatharians and large hydrocorals (*Errina* spp., *Sporadopora* sp., *Stylaster densicaulis*) among other species.

SE Atlantic - Walvis Ridge SEAFO Convention Area



Ewing Seamount



Valdivia Bank Seamounts complex

SPANISH – NAMIBIAN COOPERATION

3 multidisciplinary research cruises in 2008, 2009 and 2010
- 15 823 km² surveyed with a multibeam echosounder
- 1 462 km of seismic profiles
- 60 Bottom trawls
- 13 Rock dredge
- 18 Sedimentary dredge
- 136 CTD stations

CURRENT SITUATION

The estimated area shallower than 2000 meters in the SEAFO jurisdictional area, where VME indicator species likely occur, is around 141451 km². Essays to extrapolate a model using the depths of taxa distribution as the only variable collide with the low accuracy of the available bathymetry and the absence of appropriate data that define the limits of the geographical distribution of the taxa.

The surface mapped through the research surveys only represents around 1% of the total SEAFO seabed above 3000 m depth (1328758 km²). Thus, it is unrealistic to think that this vast and spread extension could be mapped with the same precision. However, cruises targeting specific areas or seamounts of contrasted interest might be an intermediate solution.

RAP-Sur

The depth ranged between 218 m at the outcrop in the South-eastern sector of Valdivia Bank and 3000 m in the southern part of our study area. Over the seamount, alterations of the main currents generate local currents and calm zones favoring the retention and primary production, in the first 50 db in both areas. However, oxygen profiles shown different environments until 1000 db, between Ewing (lower value) and Valdivia Bank. The SACW (South Atlantic Central Water), AAIW (Antarctic Atlantic Intermediate Water) and NADW (North Atlantic Deep Water) are present in the area. The benthic fauna associated with vulnerable marine ecosystems (VME) consisted mainly of colonial scleractinian and black corals (Antipatharia) which in turn serve as substrate to alcyonarians, solitary scleractinian (Caryophillidae) and small sessile organisms such as some anemones and barnacles. A large proportion of the scleractinian in the samples were dead, although some had distal alive polyps (*Enallopsammia rostrata*). Depth, substratum type, slope and orientation seem to be the variables affecting their patchy distribution. A total of 210 species of fish, 60 crustaceans and 32 cephalopods were recorded, while of significance was the absence of skates in the samples. Species diversity increased by depth and four assemblages by depth strata were found: shallower (200-300 m); slope (300 – 800 m); upper deep (800 - 1300 m); and deep (1300 – 2000 m).

CONCLUSIONS

Seabed mapping projects presented in this poster contributed to improve our knowledge on Vulnerable Marine Ecosystems and has been an important tool in the process of selecting areas to be protected. Areas closed to bottom fishing have a clear fisheries management objective, trying to meet the United Nations mandate. These areas focusing on the protection of seabed features and habitat forming species in the high seas have been implemented by Regional Fisheries Management Organizations and States and can be considered as examples of a network of protected areas, oriented to the sustainability of high seas fisheries at large spatial scale.

REFERENCE: Durán Muñoz, P., Sayago-Gil, M., Murillo, F.J., Del Rio, J.L., López-Abellán, L.J., Sacau, M. and Sarralde, R. (2012) Actions taken by fishing Nations towards identification and protection of vulnerable marine ecosystems in the high seas: the Spanish case (Atlantic Ocean). *Marine Policy* 36, 536-543.